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NEW YORK STATE COLLEGE OF AGRICULTURE,

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GRAPE YIELDS, COSTS AND RETURNS

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Prepared for
The Grape Committee of the Chautauqua Grape Belt

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Contents

GRAPE YIELDS

	Page number
Yields, all Varieties, for Year Cost Data Obtained	3
Concord Yields 1924-1928	3- 4
Frequency Distribution 1924-1928	4- 5
Variation in Yield One Year to the Next .	6- 7
Chances of Recurring Yields on the Same Vineyards being Above or Below the Community Average	8- 9
Yields of Odd Varieties	10
Concord Yield by Ages - Young Vineyards .	11
Vineyards of Full Bearing Age	11-12
Concord Yields by Ages and Soil Types Michigan Vineyards	12-13
Chautauqua-Erie Vineyards	13-14
Relation of Yields to Costs Hours of Labor	15-16
Returns and Cost Per Hour of Labor . .	17
Cost Per Acre and Per Ton	18-19

GRAPE YIELDS

Yields, all Varieties, for Year Cost Data Obtained

The average yield on the vineyards studied in Chautauqua County, New York for 1928 was 1.63 tons, (table 1). The average yields in 1928 for the vineyards studied about Hector, Bluff Point, Pulteney and Naples in the Finger Lakes region were below the Chautauqua average.

Table 1. Vineyard yields, 1928. (Averages for vineyards 6 years and older, all varieties.)

Area	Tons per acre	Yield index Chautauqua equals 100
Hector, Schuyler County, New York	1.22	75
Arkansas (1929)	1.43	88
Bluff Point, Pulteney, Naples, N. Y.	1.48	91
Chautauqua County, New York	1.63	100
Michigan	1.86	114
Niagara County, New York	2.01	123
North East, Pennsylvania	2.07	127
Seneca County, New York	2.20	135
Girard, Pennsylvania	2.41	148
Hudson Valley, New York	2.46	151

The average yield in 1929 for the vineyards studied in Arkansas were also below the 1928 Chautauqua average. In 1929 mildew and rot reduced the yield in Arkansas. In two vineyards studied the grapes were not harvested. Some growers estimated that about one-third of the berries were shook off when picked.

Six of the areas studied had higher average yields in 1928 than Chautauqua's. The highest averages were obtained on the vineyards studied about Girard, Pennsylvania and in the Hudson Valley, New York. The average yield in these areas was over 2 2/5 tons per acre. These averages were 50 per cent higher than Chautauqua's average of 1.63 tons.

Concord Yields 1924-1928

The average of the yields from 1924 to 1928 for the Chautauqua vineyards was 1.63 tons. This was the same as the 1928 average. The average yield of Concord grapes for each of the areas listed in table 2 was higher than Chautauqua's average. A spring freeze in 1927 cut Arkansas' average yield to one-half ton. This was the only area in 1927 with a yield below Chautauqua's.

In 1926 Michigan and the Finger Lakes regions were the only areas to average less than 2 tons of grapes per acre. The average for the Chautauqua vineyards in 1926 was 2.59 tons.

In 1925 the Michigan vineyards averaged two-thirds of a ton and Chautauqua vineyards one ton. Michigan was the only area in 1925 to have an average yield below Chautauqua's. In 1924 the yields on the Chautauqua and Bluff Point vineyards averaged lower than did the yields in North East, Michigan or the Hudson Valley.

Table 2. Concord yields by areas 1924-1928. (Vineyards of full bearing age.)

Area	Yield per acre					
	:1928:	:1927:	:1926:	:1925:	:1924:	Average
	tons	tons	tons	tons	tons	tons
Chautauqua	1.63	1.12	2.59	1.01	1.80	1.63
Michigan	1.90	1.56	1.87	0.67	2.36	1.67
Bluff Point 1/	1.65	1.68	1.98	1.49	1.80	1.72
Arkansas	2.52	0.51	2.99	1.70	--	1.93
North East	2.12	1.41	2.51	1.36	2.13	1.91
Girard	2.68	2.09	2.99	2.18	--	2.48
Hudson Valley	2.48	2.61	2.82	2.50	2.94	2.67
	Yields in per cent of Chautauqua's yield					
	per cent	per cent	per cent	per cent	per cent	per cent
Chautauqua	100	100	100	100	100	100
Michigan	117	139	72	66	131	105
Bluff Point 1/	101	150	76	148	100	115
Arkansas	155	46	115	168	---	121
North East	130	126	97	135	118	121
Girard	164	187	115	216	---	170
Hudson Valley	152	233	109	248	163	181

1/ Also includes vineyards about Pulteney and Naples.

An average for the five-year period 1924-1928 showed that Michigan's yields averaged about the same as Chautauqua's; that the yields in Bluff Point, Pulteney, Arkansas and North East averaged about one-fifth higher than Chautauqua's and that yields in Girard and the Hudson Valley averaged four-fifths higher than Chautauqua's.

Frequency Distribution of Yields 1924-1928

In 1926 for the 93 Chautauqua vineyards studied there was one vineyard with a yield of less than one ton and two vineyards with yields of over five tons. Over half the vineyards in 1926 had yields between 2 and 3.50 tons per acre. In 1925, 36 vineyards and in 1927, 37 vineyards yielded less than one ton per acre. In every year there were some vineyards that yielded better than three tons per acre.

Table 3. Frequency distribution of Concord yields for each year, 1924-1928. Chautauqua County, New York.

Tons of grapes per acre	Number of vineyards having yields as designated				
	1928	1927	1926	1925	1924
	number	number	number	number	number
Under 1	6	37	1	36	8
1.0 - 1.49	34	36	6	26	13
1.50 - 1.99	44	16	18	13	15
2.00 - 2.49	16	4	20	3	12
2.50 - 2.99	10	2	14	0	11
3.00 - 3.49	2	2	20	2	3
3.50 - 3.99	0	0	7	0	3
4.00 - 4.49	0	1	5	0	1
5.00 - 5.99	0	0	2	0	0
Total	112	98	93	80	66

The average (median) occurs in the group underlined.

About 10 per cent of the Chautauqua yields from 1924-1928 were 3 tons or over. The other 6 areas listed in table 5 had a larger proportion of the yields 3 tons and over than did Chautauqua. In Girard, Pennsylvania $\frac{1}{4}$ of the yields and in the Hudson Valley $\frac{2}{5}$ of the yields were reported as 3 tons or over.

One-quarter of the yields in Arkansas were under 1 ton. This was the largest proportion of such low yields in any of the areas studied. The yields for 1929 were included in Arkansas but not in the other areas. Chautauqua and Michigan were the next areas having the largest proportion of low yields. Nearly 1/5 of their yields were less than one ton.

Table 4. Frequency distribution of annual Concord yields by areas, 1924 to 1928.

Area	Tons of grapes per acre							
	:under:	1.00:	1.50:	2.00:	2.50:	3.0 :	3.5 :	
	: 1.0 :	1.49:	1.99:	2.49:	2.99:	3.49:	plus:	
	Per cent of total number of vineyards							
	%	%	%	%	%	%	%	%
Chautauqua	19.6	25.6	<u>23.6</u>	12.3	8.2	6.5	4.2	
Michigan	19.2	22.5	<u>21.3</u>	13.0	12.7	5.6	5.8	
Finger Lakes	12.5	27.1	<u>20.5</u>	18.9	7.3	9.4	4.2	
Arkansas 1/	24.7	15.3	<u>16.8</u>	11.1	11.1	6.8	14.2	
North East	11.0	22.1	<u>18.7</u>	21.7	13.6	7.0	5.9	
Girard		4.2	12.8	<u>12.8</u>	23.4	21.3	14.9	10.6
Hudson Valley		1.0	8.7	11.6	<u>18.5</u>	16.5	18.5	25.2

The average (median) occurs in the group underlined.

1/ Yields from 1925-1929

Variation in Yield from one Year to the Next.

There is a tendency for vineyards to bear heavier every other year as is shown by the average yields from 1924 to 1928 for each of the areas, table 2. Beginning in 1924 yields were lower in 1925, higher in 1926, lower in 1927 and higher in 1928. Out of 19 comparisons there were only 2 exceptions to the alternate up and down swing in yields.

For individual vineyards mentioned in table 5, alternate yields occurred 72 per cent of the time. The changes in yield from one year to the next were unlike 119 times and alike 45 times. Fruit growers and horticulturists have for years been studying the problem of how to secure better yields in the off years.

Much of the variability from one year to the next in eastern vineyards and orchards has been caused by the variability of eastern climate. Nearly all of the commercial fruit growing regions in the East that have persisted in fruit production over a long period of time are situated near large bodies of water. The necessity of retarding spring growth until after the danger of frosts is especially important in grape production. But even in the most favored locations in the East, variations in yield and quality of fruit have been constantly recurring because of untimely frosts, too much or too little rain, sunshine, etc. On the Pacific Coast, where water is supplied by irrigation and where the climate is very uniform, the yields from year to year are relatively uniform.

How great the variation in yield is from year to year in some eastern vineyards and regions is shown in table 5. On farm number 39, Chautauqua County, New York, the difference between one year's yield and the next for a 40-year period (1890-1929) averaged 0.91 of a ton. The average yield was 2.33 tons. The variation in yield was 39 per cent of the yield. The percentage that the variation in yield was of the average yield varied from 10.5 per cent in the Hudson Valley area to 97.8 per cent for a vineyard in Arkansas. The average variation in yield in the Chautauqua area was about 2/3 of the average yield. The variation in grape yields from year to year has averaged about the same as the variation in apple yields in Niagara County.

The average variation in grape yields in Arkansas has been almost as large as the average yield. Vineyards produce unusually well in Arkansas in favorable seasons. On April 21, 1927 a white frost occurred when the grape shoots were a foot or two long. There is no body of water in this area to retard spring growth. Mildew and rot in some years have been more severe in Arkansas than in the other areas studied.

Table 5. Variation in grape yields from one year to the next by areas and individual vineyards.

Area or vineyard	Variety	Period	Years	Number	Average yield per year	Average variation per year	Percentage variation was of average yield per cent
Hudson Valley area	Concord	1924-1928	5	2.67	0.28	10.5	
Bluff Point, Pulteney, Naples area	Concord	1924-1928	5	1.72	0.28	16.3	
Chautauqua Co. No. 39	Concord	1890-1929	40	2.33	0.31	39.1	
Seneca County, Number 3	Niagara	1920-1928	9	1.96	0.62	41.8	
Bluff Point, Number 34	Concord	1888-1928	41	1.81	0.81	44.8	
North East area	Concord	1924-1928	5	1.91	0.93	48.7	
North East, Number 39	Concord	1910-1928	19	2.55	1.28	50.2	
Michigan area	Concord	1920-1928	9	1.78	0.91	51.1	
North East, Number 28	Concord	1920-1928	9	2.20	1.39	63.2	
Chautauqua area	Concord	1924-1928	5	1.63	1.09	66.9	
Bluff Point, Number 29	Catawba	1910-1928	19	1.10	0.74	67.3	
Michigan, Number 23	Concord	1920-1928	9	2.61	1.86	71.3	
Bluff Point, Number 34	Niagara	1910-1928	19	0.78	0.57	73.1	
Bluff Point, Number 34	Catawba	1910-1928	19	0.69	0.61	88.4	
Arkansas area	Concord	1925-1929	5	1.85	1.69	91.4	
Arkansas, Number 49	Concord	1920-1928	9	1.34	1.31	97.8	

Other Fruits

Niagara Co., N. Y.	Apples	1913-1926	14	bushels	bushels	
Newfane area 1/			160	85	53.1	
Niagara Co., N. Y.	Peaches	1913-1926	14	92	76	82.6
Newfane area 1/						

1/ The Apple Situation in New York, by G. P. Scoville and others, Cornell Extension Bulletin 172.

Chances of Recurring Yields on the Same Vineyard
being Above or Below the Community Average

The fertility of the soil, the drainage, the owner, are some of the factors affecting a vineyard's production which have about the same influence on yield from year to year. Thus, there are some vineyards that usually yield better most seasons than the average of the community and other vineyards that usually yield poorer. Twenty-two per cent of the 373 vineyards reported in table 6 had yields above the average for each year that yields were reported. If the yields on a vineyard over a period of years were unrelated then the proportion would have been about 9.4 instead of 22 per cent.

Table 6. Number of vineyards having yields above or below the average of their neighbors, for designated periods of years. (Concord vineyards, 6 years and older, all areas.)

Yields compared : Number of years for which yields were reported :												
with the average:	2	:	3	:	4	:	5	:	6 to :	9	:	Total :
<u>yield of neighboring vineyards: Number of vineyards having yields as indicated :</u>												
	number											
All years above	31	13	4	32	2							82
All years below	22	21	7	25	1							76
Some years above, some below	21	36	42	92	24							215
Total	74	70	53	149	27							373
<u>Distribution : Per cent of vineyards with yields above average for all years :</u>												
	percent											
Actual	41.9	18.6	7.5	21.5	7.4							22.0
Chance 1/	25.0	12.5	6.25	3.125	0.45							9.4

1/ Chance distribution of yields over a period of years on the same vineyard if yields were unrelated.

There were 149 vineyards that reported yields for 5 years. Thirty-two of these vineyards had yields above the average for each of the 5 years. If 5 coins were tossed 149 times, all 5 coins would turn heads, on the average, in 5 out of 149 tries. If each year's yield on a grape vineyard was independent of the yields for other years there would have been about 5 instead of 32 vineyards to have yields all above the average.

With no information about a vineyard the chances are even or one-half that the yield the next year will be above average since about half the vineyards yield above the community average and half below. If a vineyard is known to have yielded above average in preceding years the chance that the next year's yield will be above average is better than one-half, table 7. There were 1158 yield comparisons for two years. The yield the first year was above average in 578 of the comparisons and below average in 580.

The proportion of yields above the average the next year were 67.6 per cent and 37.2 per cent respectively. The chances were twice as great for a yield above average if the preceding years yield was above rather than below the average.

Table 7. The chances of a vineyard yielding above or below the average of the neighbors if in preceding years yields had been above average, or if in preceding years yields had been below average. (Concord vineyards, 6 years and older, all areas.)

Yields for pre- ceding years	Yields following year				
	Number : vineyards	: above average	: below average	: above average	: below average
All yields were above average for	number	number	number	percent	percent
One year	1/ 578	391	187	67.6	32.4
Two years	250	183	67	73.2	26.8
Three years	112	93	19	85.0	17.0
Four years	49	44	5	89.8	10.2
Below average for					
One year	1/ 580	216	364	37.2	62.8
Two years	245	64	181	26.1	73.9
Three years	103	27	81	25.0	75.0
Four years	38	7	31	18.4	81.6

1/ Vineyards were counted as many times as yields were given for two consecutive years. As an example a vineyard with a yield above the average from 1926, 1927 and 1928 would be counted twice in the first group of 578 vineyards.

of having a yield above average

The chances increased as the number of years with yields above average increased. With one year above average the chance was $2/3$; with 2 years $3/4$; with 3 years $4/5$ and with 4 years $9/10$.

For vineyards reporting yields for two consecutive years there were 41.9 per cent that had yields for both years above the average. For vineyards reporting yields for more than two years there were only 17.1 per cent that had yields above the average for each of the years reported. The distribution of yields on the same vineyards from one year to the next would indicate that faulty pruning which results in an excessive crop one year and a very light crop the next (1/) or biennial bearing was not of sufficient importance to cause an unusual number of vineyards to yield above their neighbor one year and below the next. The distribution would also indicate that there are relatively few vineyards that yield every year a crop larger than the average of their neighbors. Most of the best vineyardists fail some years to get average yields.

1/ "Profitable Pruning of the Concord Grape." N. L. Partridge. Special Bul. No. 141, Agricultural Experiment Station, Michigan Agricultural College.

Yields of Odd Varieties

The only varieties that exceeded Concord in yields were Champion in Michigan, Worden in Michigan and Hudson Valley and Niagara in Niagara County, table 8. In North East, Finger Lakes and Michigan the Niagara yield was below Concord. On the average for all areas the Niagara yielded about 4/5 as well as Concord.

Table 8. Yields for each of the odd varieties compared with Concord yields on the same farm for the same year.
(Vineyards 6 years and older having at least one acre of designated variety.)

Variety	Area	Yield per acre		Concord	Per cent:
		Weighted by acreage	Average of the averages	(average of the averages)	of Concord yields
Niagara	Niagara Co.	2.36	2.26	2.09	108
	North East	1.55	1.84	2.11	87
	Finger Lakes	1.64	1.38	1.73	80
	Michigan	1.12	1.08	1.57	69
	All areas	1.69	1.51	1.82	83
Catawba	Finger Lakes	0.92	0.92	1.54	60
Delaware	Michigan	1.08	1.13	1.55	73
	Finger Lakes	0.90	0.94	1.62	58
Worden	Michigan	1.60	1.89	1.64	115
	Hudson Valley	2.45	2.35	2.05	115
	Finger Lakes	1.31	1.15	1.54	75
	All areas	1.62	1.84	1.72	107
Champion	Michigan	2.21	2.09	1.46	143
Moore Early	Michigan	1.18	1.20	1.70	71
	Arkansas	0.74	0.84	1.56	54
Ives	All areas	1.46	1.19	1.49	80
All odd varieties	All areas	1.37	1.42	1.68	85

The Worden yielded 15 per cent better than Concord in Michigan and in the Hudson Valley. The average for all areas was 7 per cent higher than Concord.

The Catawba, Delaware and Moore Early yielded about two-thirds as well as Concord.

Concord Yields by Ages
Young Vineyards

During the third season of growth vineyards began to bear, and on the average produced about 1/5 of a ton per acre, table 9. This was about 12 per cent of an average crop for vineyards of full bearing age. In the fourth season vineyards averaged 2/3 of a ton per acre or 39 per cent of a full crop, and in the fifth season 1.58 tons or 88 per cent of a full crop. Five-year old vineyards produced about twice as much as 4-year old vineyards. In the sixth season the average yield was 1.71 tons or 95 per cent of a full crop.

Table 9. Concord yields on young vineyards by ages, average yield for all years.

Age (Seasons of growth)	Yield per acre			Increase in yield for ad- ditional season of growth			
	Chautauqua: North East: and Girard:	Arkansas: All areas	Chautauqua: North East: and Girard:	Arkansas: All areas	Chautauqua: North East: and Girard:	Arkansas: All areas	Chautauqua: North East: and Girard:
years	tons	tons	tons	tons	tons	tons	tons
2	0.00	0.06	0.01	.00	.06	.01	
3	0.14	0.35	0.21	.14	.29	.20	
4	0.65	0.75	0.69	.51	.40	.48	
5	1.29	1.68	1.58	.64	.93	.89	
6	1.59	1.76	1.71	.30	.08	.13	
7	1.77	1.71	1.77	.18	-.05	.06	
Average yield for vineyards 6 yrs. and older	1.77	1.80	1.79				

The Arkansas vineyards yielded as well at five years as the Chautauqua-Erie vineyards did at six. The average yield for mature vineyards in Arkansas was 1.80 tons and 1.77 tons in the Chautauqua-Erie belt.

Vineyards of Full Bearing Age

On the average, there was no apparent decline in Concord yields for vineyards up to 34 years of age, table 10. The group of vineyards from 35-39 years of age showed a decrease in production of about 10 per cent. This was a decline of about 1/5 of a ton in yield. Vineyards from 40-49 years of age yielded about $1\frac{1}{2}$ tons per acre. This was 0.3 of a ton less than the younger vineyards produced at their prime. Vineyards 50 years old and older averaged 1.35 tons per acre.

Table 10. Concord yields by ages. (Average for all areas and for years that yields were reported from 1920-1929.)

Age of vineyards	Per cent of communities'	Average yield 1/ 1920 - 1929
years	per cent	tons
5- 9	97.5	1.75
10-14	101.2	1.81
15-19	102.4	1.83
20-24	101.7	1.82
25-29	100.1	1.79
30-34	100.6	1.80
35-39	90.6	1.62
40-44	82.4	1.48
45-49	85.8	1.54
50 and older	75.1	1.35

1/ The average yield for all areas for the years yields were reported was 1.791 tons. The per cent of the communities' average was multiplied by 1.791 tons to obtain the average yield by age groups.

On the average the productiveness of the soil and vineyards have been kept up for at least 30 years.

Grape Yields by Age and Soil Type Michigan Vineyards

Many of the vineyards about Lawton and Mattawan, Michigan were planted on soils belonging to the Plainfield and Coloma series. These soils were nearly pure sand and have an open structure which furnishes good to excessive drainage. Most of the other soils used for grapes in Van Buren County, Michigan belong to Bellefontaine and Fox series. These soils have generally a loam or sandy loam texture. The subsoil is more compact than the sandy soils but sufficiently open to provide adequate drainage.

On an average the sandy soils yielded almost 2/3 of a ton less than the other soils, table 11. This difference in yield was primarily due to the difference in the natural fertility between the loam and the sandy soils.

Table 11. Concord grape yields on loam and sandy soils in Michigan. (Vineyards 6 years and older, average yields 1920-1928.)

Age of vineyards years	Grape yields per acre		
	Loam, sandy loam soils 1/.	Sandy soils 2/ (Subsoil very soil less open)	Difference
	tons	tons	tons
Under 20	1.95	1.34	0.61
20-34	2.07	1.44	0.63

- 1/ The loam soil group were the farms having all or most of farm located on one or more of the following soil types: Fox loam, Fox sandy loam, and Bellefontaine sandy loam.
 2/ The sandy soil group were farms located on the Coloma sandy loam or Plainfield sand.

Wind erosion has been serious on some vineyards set on very sandy soils. Water erosion has also affected the productiveness of some vineyards set on hillsides. Years of cultivation accompanied with neglect to maintain humus supply has decreased production. Nevertheless, there was, on the average, no decrease in the production of Michigan Vineyards up to 30 years of age. This applies to vineyards on the sandy as well as on the loam soils.

Chautauqua-Erie Vineyards

The soils about Westfield, New York on the Lake Plain belong to the Dunkirk series, 1/. The texture varies from a gravel to a clay. Most of the gravels occur along the ridge where U. S. Highway No. 20 is built. Most of the soil about Westfield between the Lake and the New York Central tracks was classified as "Dunkirk silty clay loam." For the vineyards studied the yields averaged about the same on the silty clay loam as on the gravel. Drainage on the Dunkirk soils is fair to good.

Most of the soils on the hills near Westfield belong to the Volusia series. These soils were described in the soil report as follows: "The retention of water is due to the combination of a rather loose and absorbent top soil with a compact and quite impervious subsoil. The surface slope of the land has small potency to drain the land in this case since the removal of water is determined by the rate of percolation through the soil on top of the impervious layer and this is slow. Consequently, such land is soggy, cold, and late and has a shortened growing season. The hill land generally has this undesirable condition, but it is far less noticeable in the Wooster than in the Volusia series."

1/ Soil survey of Chautauqua County, New York, T. M. Morrison and others, Cornell Extension Bulletin 6, October 1916.

A small amount of the hill land about Westfield belongs to the Wooster soils and is about as well drained as the Dunkirk.

The vineyards studied about North East and Westfield located on the lake plain soils averaged 1.85 tons of grapes per acre, table 12. The older vineyards on the lake plain yielded as well as the younger vineyards. Vineyards on the hill soils in these communities averaged 1.53 tons for the younger vineyards and only 1.11 tons for the older vineyards.

Table 12. Concord grape yields on Hill and Lake Plain soils.
(Chautauqua-Erie vineyards, 6 years and older;
average yields 1924-1929).

Age of Vineyards years	Grape yields per acre		
	Lake Plain soils		Hill soils
	tons	tons	Difference
Under 20	1.85	1.53	0.32
20 to 31	1.86	1.11	0.75

Altho the young vineyards in the hills yielded about 1/3 of a ton less per acre than the lake plain vineyards the yield on the hill vineyards was maintained until the vineyards were about 15 years old. Then the yields began to decline as the vineyards increased in age. The oldest vineyards on the hills were about 30 years of age and produced on the average about one ton of grapes per acre.

The effects of poor drainage are accumulative. Vineyards may do fairly well the first few years, but wet seasons cause root injury and weakened condition of the vines. Vineyards on poorly drained soils do not recover from these set backs. Their root development is not adequate to withstand droughty conditions. Each extremely wet or dry season leaves the vineyards slightly weaker and a little less productive.

Some of the sandy soils of Michigan are situated on hills and appear to suffer more from sheet erosion than the hill vineyards in the Chautauqua-Erie region. If erosion was the cause of the decreasing yields on the hill vineyards it would seem that the Michigan vineyards would show this decrease as well as the Chautauqua-Erie vineyards. The old vineyards on the sandy soils in Michigan were as productive as the young vineyards. The reason for this is that the sandy soils in Michigan were very well drained.

Relation of Yield to Costs

Hours of Labor

The total hours of man labor per acre of vineyard was lowest for the farms studied in Niagara County, New York and Michigan, averaging respectively 92 and 96 hours per acre, table 13. This included all the labor spent on grapes, hired and unpaid. It includes labor for picking and delivering to market as well as all labor growing.

The most labor was used in Arkansas, 175 hours per acre, and in the Hudson Valley, 215 hours per acre. This was about twice as much labor per acre as was used in Niagara County and Michigan. Twenty-three of the 35 vineyards studied in the Hudson Valley were intercropped with currants or other fruits. Good fruit land near New York City is relatively high in price and is worked intensively. Labor is relatively cheap in Arkansas. More spraying was done in Arkansas and more time was spent in harvesting the crop than in the other areas. Ninety-seven per cent of the grapes shipped by rail on the farms studied in Arkansas were in 4 quart baskets. The practice in Arkansas is to pick the grapes from the vines in the 4 quart baskets.

The time required in Chautauqua County averaged 105 hours per acre or 65 hours per ton. The time required per ton varied from 46 hours in Niagara County and Girard to 134 hours per ton in Arkansas. The time required per ton varied with the yield. For vineyards producing less than one ton per acre it took 96 hours per ton in Chautauqua County and 149 hours per ton in Arkansas. The average yield of vineyards, yielding less than one ton for all areas, was 0.69 of a ton. The next lowest yielding group averaged 1.29 tons per acre. The hours per ton on the lowest yielding group averaged 136 and in the next lowest yielding group 80. This was a difference of 56 hours per ton. A comparison of the two highest yielding groups showed a difference of only 4 hours per ton. The average per ton was 51 hours for vineyards yielding 2.67 tons per acre and 47 hours for vineyards yielding 3.44 tons. An increase in yield of 0.60 tons per acre was a great deal more important in the 0.69 yield group than in the 2.67 ton yield group.

It requires a great deal of labor per ton to care for a very low producing vineyard. The grower who works a vineyard that usually produces about a ton or less of Concord grapes has a very poor job. Unless the yield on such vineyards can be economically increased, their abandonment would probably result to the financial benefit of their owners.

Table 13. Total hours of labor on grapes including labor growing, picking and marketing for designated yields. 1928 1/

Area	Tons per acre						
	All		1.00: 1.50: 2.00: 2.50:				
	vine-		Under:	to :	to :	to :	to : 3 and:
	yards		1.0	1.49	1.99	2.49	2.99: over
	Hours of labor per acre						
Niagara Co., N. Y.	hours	hours	hours	hours	hours	hours	hours
Michigan	92	2/	2/	86	98	3/	3/
Michigan	96	80	73	94	103	126	160
North East, Pa.	102	2/	88	96	104	107	133
Girard, Pa.	103	2/	97	2/	108	2/	99
Chautauqua Co., N. Y.	105	75	89	111	122	158	3/
Finger Lakes, N. Y.	122	100	112	132	143	2/	161
Arkansas 1/	175	103	173	205	260	3/	3/
Hudson Valley, N. Y.	215	-	195	3/	222	3/	223
Average	116	93	103	115	124	135	162
Hours of labor per ton							
Niagara Co., N. Y.	hours	hours	hours	hours	hours	hours	hours
Girard, Pa.	46	2/	2/	56	40	3/	3/
Girard, Pa.	46	2/	119	2/	53	2/	32
North East, Pa.	49	2/	71	57	46	40	40
Michigan	52	106	57	54	46	47	45
Chautauqua Co., N. Y.	65	96	72	65	56	56	3/
Finger Lakes, N. Y.	80	139	88	77	66	2/	54
Hudson Valley, N. Y.	88	-	133	3/	89	3/	62
Arkansas 1/	124	149	127	117	105	3/	3/
Average	.65	136	80	67	55	51	47
Decrease from preceding group	--	--	56	13	12	4	4
	tons	tons	tons	tons	tons	tons	tons
Average yield per acre	1.78	0.69	1.29	1.72	2.26	2.67	3.44
Number of vineyards							
	No.	No.	No.	No.	No.	No.	No.
Niagara Co., N. Y.	20	1	3	7	7	1	1
Girard, Pa.	27	4	3	4	8	4	4
North East, Pa.	76	2	13	20	21	13	7
Michigan	92	4	21	27	19	16	5
Chautauqua Co., N. Y.	114	6	35	48	13	10	2
Finger Lakes, N. Y.	113	17	39	26	15	7	9
Hudson Valley	35	0	4	4	8	9	10
Arkansas 1/	78	23	18	22	10	3	3
Total	555	57	136	158	101	62	41

1/ Arkansas data for the year 1929.

2/ Because of the small number the records in this group were averaged with the records in the next group following.

3/ Because of the small number the records in this group were averaged with the records in the preceding group.

Returns and Cost per Hour
of Labor used on Grapes

The labor used on the Chautauqua vineyards studied cost, on the average, 43 cents per hour. The labor cost in all the other areas, except Arkansas, was about the same as Chautauqua's cost. The average cost of labor on the Arkansas vineyards was only 21 cents per hour. In arriving at the expense for labor hired, labor was charged at cost. This included cost of privileges as well as cash wages. The labor of the operator and members of his family when not paid wages were charged at what the grower estimated such labor would cost if hired.

If all the vineyard costs except labor, are subtracted from the grape sales and the difference divided by the total hours of labor spent on grapes, the quotient shows the returns per hour of labor. The returns per hour of labor was lowest in Chautauqua County averaging 6 cents. Since labor cost, on the average, 43 cents in Chautauqua County there was a loss per hour of labor spent on grapes of 37 cents. In Arkansas the returns per hour of labor on grapes was 11 cents and 14 cents in North East, Pennsylvania. The returns per hour of labor was highest in Girard and Niagara County averaging respectively, 32 and 37 cents per hour.

Table 14. The average returns, cost and loss per hour of labor on grapes for vineyards with designated yields, 1928 1/

Area	All vineyards :			Tons per acre :					
	Per hour labor :			Under 1.0	1.50	2.00	2.50	3 and over	
	Re-	Loss	1.0	to	to	to	to	over	
	turns:	Cost:	or:		:1.49	:1.99	:2.49	:2.99	
	:	:	:gain:		Returns per hour :				
	cents	\$	cents	cents	\$	\$	\$	\$	cents
Chautauqua Co., N.Y.	6	43	-37	3/	-6	8	16	26	3/
Arkansas 1/	11	21	-10	-12	9	17	25	3/	3/
North East, Pa.	14	43	-29	2/	-6	6	18	22	39
Finger Lakes, N. Y.	20	42	-22	-2	14	29	32	2/	39
Michigan	21	40	-19	-11	7	18	31	34	44
Hudson Valley, N. Y.	22	45	-23	-	8	3/	21	3/	41
Girard, Pa.	32	42	-10	2/	11	2/	20	2/	60
Niagara Co., N. Y.	57	46	+11	2/	2/	33	81	3/	3/
<hr/>									
Averages (all areas)									
Returns per hour	16	-	-	-	7	5	14	26	29
Cost per hour	-	39	-	34	38	38	40	42	43
Loss per hour	-	-	23	41	33	24	14	13	2

1/ Arkansas data for year 1929

2/ Because of the small number the records in this group were averaged with the records in the next group following.

3/ Because of the small number the records in this group were averaged with the records in the preceding group.

The returns per hour of labor on grapes varied with the yield. For vineyards in Chautauqua County yielding less than 1.5 tons per acre the sales from grapes in 1928 lacked 6 cents an hour of being enough to pay for the other costs and nothing for labor. On vineyards yielding 2.50 or more tons per acre the returns per hour of labor averaged 26 cents. For all areas the returns per hour of labor on vineyards yielding 3 tons or more averaged 41 cents and labor cost 43 cents. With 1928 grape prices even on the best producing vineyards the return for labor was 2 cents per hour less than it cost.

Cost per Acre and per Ton of Grapes

The cost of growing grapes per acre, not including picking and marketing, was lowest for the vineyards studied in Michigan averaging \$59 per acre and highest in the Hudson Valley averaging \$132. The average for the Chautauqua County vineyards was \$75 per acre. The growing costs per acre were much higher on the higher yielding vineyards. The costs per acre in Chautauqua County averaged \$47 for the lowest yielding group to \$104 per acre for the highest yielding group.

The cost of harvesting and marketing a ton of grapes, not including the cost of baskets, averaged \$11 per ton in Girard and \$13 per ton in Michigan, Chautauqua and North East. The harvesting costs were low in Girard because $\frac{1}{2}$ bushel baskets were used almost exclusively and because truckers took 87 per cent of the crop at the farm. The cost of harvesting and marketing was highest in Arkansas and Hudson Valley averaging \$15 and \$17 per ton.

There was not very much difference in the harvesting and marketing costs per ton between the low and high producing vineyards. Most of the grape pickers were paid by the number of baskets or trays picked and usually at the same rate regardless of yield.

The total cost per ton of growing, picking and marketing but not including baskets was lowest in Michigan averaging \$45 per ton. The average was about \$50 per ton in Niagara County, Girard and North East; and about \$60 per ton in Chautauqua, Arkansas and the Finger Lakes. The cost per ton was highest in the Hudson Valley averaging \$71. The total cost per ton varied in Chautauqua County from an average of \$97 per ton in the lowest yielding group of vineyards to \$47 and \$52 per ton in the highest yielding groups. For all the areas, the cost per ton for the lowest yielding group of vineyards averaged \$99 and for the vineyards yielding 3 tons and over \$41 per ton. The cost per ton on the best yielding vineyards averaged only $\frac{1}{2}$ as much as on the poorest yielding group.

Table 15. Cost of producing grapes at designated yields per acre, 1928 1/

Area	Tons per acre						
	All	Under:	1.00	1.50	2.00	2.50	3 and over
	vine	1.0	to	to	to	to	over
	yards		1.49	1.99	2.49	2.99	
	\$	\$	\$	\$	\$	\$	\$
	Growing costs per acre excluding picking and marketing						
Michigan	59	54	51	61	63	65	73
Arkansas 1/	60	51	64	62	65	3/	3/
Niagara Co., N. Y.	70	2/	2/	66	74	3/	3/
Finger Lakes, N. Y.	71	65	67	76	76	2/	78
Chautauqua Co., N. Y.	75	47	69	77	78	104	3/
North East, Pa.	81	2/	66	76	87	88	92
Girard, Pa.	88	2/	77	2/	88	2/	91
Hudson Valley, N. Y.	132	-	111	3/	130	3/	161
Average cost per acre	72	57	65	72	77	86	100
Increase over preceding group	-	-	8	7	5	9	14
	Harvesting costs per ton including marketing but excluding containers.						
Girard, Pa.	11	2/	27	2/	11	2/	9
Michigan	13	16	12	12	13	14	15
Chautauqua Co., N. Y.	13	16	13	14	12	15	3/
North East, Pa.	13	2/	16	14	14	12	12
Niagara Co., N. Y.	14	2/	2/	14	13	3/	3/
Finger Lakes, N. Y.	14	16	14	14	14	2/	13
Arkansas 1/	15	16	15	16	15	3/	3/
Hudson Valley, N. Y.	17	2/	25	3/	18	3/	12
Average	13	16	14	13	13	14	12
	Total cost per ton, including growing, picking, marketing, excluding containers.						
Michigan	45	86	51	47	40	38	36
Niagara Co., N. Y.	49	2/	2/	57	43	3/	3/
Girard, Pa.	50	2/	123	2/	54	2/	39
North East, Pa.	52	2/	70	59	52	45	40
Arkansas 1/	58	104	61	52	41	3/	3/
Chautauqua Co., N. Y.	59	77	68	58	47	52	3/
Finger Lakes, N. Y.	60	106	67	59	49	2/	39
Hudson Valley, N. Y.	71	-	101	3/	70	3/	57
Average	54	99	64	55	48	46	41
Decrease over preceding group	-	-	35	9	7	2	5

1/ Arkansas data for the year 1929.

2/ Because of the small number the records in this group were averaged with the records in the next group following.

3/ Because of the small number the records in this group were averaged with the records in the preceding group.

